

APPENDIX 2: PALEONTOLOGIC ANALYSES FOR THE DMW1 MONITORING SITE

The analyses of micro-fossils from core and cuttings samples were provided by Kristin McDougall (USGS, Geologic Division) and the analyses for mega-fossils from core samples were provided by Charles Powell (USGS, Geologic Division). The following summarizes the identification of the micro-fossil and mega-fossil samples.

Micro-Fossil Analysis

FORM 9-1861

(JULY 1986)

U.S. DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY
REPORT ON REFERRED FOSSILS

Stratigraphic Range Pliocene	Shipment Number WWRD-00-1
General Locality (state, country, ocean, etc.) California	Number of Samples 13
Quadrangle or Area USGS Marina 7.5-minute Quadrangle	Region (county, province, sea, etc.) Monterey County
Fossil Type(s) Foraminifers	Referred By R. T. Hanson, Water Resources Division
Formation Purisima Formation (?)	Report By Kristin McDougall
Latitude: 36° 41' 57" N Longitude: 121° 48' 27" W	Report Date Jan. 30, 2001

Project: WRD Project 470656400; R.T. Hanson, Project Chief

Core and cuttings samples were submitted from the Marina Well (DMW1) for foraminiferal analysis. This well is located in Marina State Park, Marina, Monterey County, California. Latitude: 36° 41' 57" N; Longitude: 121° 48' 27" W (fig. 1)

Mf10316 (Field number DMW-1 Core 1, 34–35 cm, depth = approximately 823.12–823.15 feet)
No micro-fossils were observed in this sample.

Mf10317 (Field number DMW-1 Core 1, 65 cm, depth = approximately 824.13 feet)
No micro-fossils were observed in this sample.

Mf10318 (Field number DMW-1 Core 7, 127–128 cm, depth = 1,106.17–1,106.38 feet)
Benthic foraminifers
Bolivina advena striatella (Cushman) - probably reworked
Bolivina cf. *B. decussata* (Brady)
Bolivina californica (Cushman)- probably reworked
Bolivina foraminata (Stewart and Stewart)
Bolivina interjuncta (Galloway and Wissler)
Bolivina marginata (Cushman)
Bolivina vaughani (Natland)
Buccella frigida (Cushman)
Elphidiella hannai (Cushman and Grant)
Elphidium hughesi (Cushman and Grant)
Nonionella cushmani (Stewart and Stewart)
Nonionella miocenica (Cushman)
Uvigerina juncea (Cushman and Todd)
Valvulineria cf. *V. californica* (Cushman)—juveniles, probably reworked

Mf10319 (Field number DMW-1 Core 10, 17–18 cm, depth = 1,262.56–1,262.59 feet)

Benthic foraminifers

Mf10320 (Field number DMW-1 Core 10, 73–74 cm, depth = 1,264.40–1,264.43 feet)

No micro-fossils were observed in this sample.

Mf10321 (Field number DMW-1 Core 12, 86–89 cm, depth = 1,274.82–1,274.92 feet)

Benthic foraminifers

Elphidiella hannai (Cushman and Grant)

Mega-fossil fragments

Fish debris

Mf10322 (Field number DMW-1 Shaker-Cuttings No. 1, 1,225–1,230 feet)

Benthic foraminifers

Buccella frigida (Cushman)

Elphidiella hannai (Cushman and Grant)

Elphidium hughesi (Cushman and Grant)

Nonionella cushmani (Stewart and Stewart)

Nonionella miocenica (Cushman)

Vavulineria californica (Cushman) - juveniles

Mf10323 (Field number DMW-1 Shaker-Cuttings No. 2, 1,365–1,370 feet)

Benthic foraminifers

Buccella frigida (Cushman)

Elphidium hughesi (Cushman and Grant)

Elphidiella hannai (Cushman and Grant)

Nonionella cushmani (Stewart and Stewart)

Nonionella miocenica (Cushman)

Mf10324 (Field number DMW-1 Shaker-Cuttings No. 3, 1,410–1,420 feet)

Benthic foraminifers

Elphidiella hannai (Cushman and Grant)

Elphidium hughesi (Cushman and Grant)

Nonionella cushmani (Stewart and Stewart)

Mf10325 (Field number DMW-1 Shaker-Cuttings No. 4, 1,640–1,660 feet)

Benthic foraminifers

Elphidium hughesi (Cushman and Grant)

Mf10326 (Field number DMW-1 Shaker-Cuttings No. 5, 1,900 feet)

No micro-fossils were observed in this sample.

Mf10327 (Field number DMW-1 Shaker-Cuttings No. 6, 1,940 feet)

No micro-fossils were observed in this sample.

Mf10328 (Field number DMW-1 Shaker-Cuttings No. 7, 1,960–1,980 feet)

No micro-fossils were observed in this sample.

Age: Pliocene

Benthic foraminifers are present in the Marina Well in a core sample at 1,151.99–1,152.38 and 1,305–1,306.24 feet below land surface and in shaker samples from 1,225–1,230 to 1,640–1,660 feet below land surface. Micro-fossils in this 508-foot sequence are Pliocene in age. The Pliocene age is based on the presence of *Elphidium hughesi* and *Nonionella cushmani*, which are characteristic of the Purisima Formation and are not commonly found in the younger Quaternary deposits. The abundance and dominance of these species in this section corresponds to the lower part of the middle Purisima Formation (*Elphidiella hannai* zone) as described by Goodwin and Thompson (1954) from the section at Half Moon Bay. Sample Mf 10318 (core 7), which contains *Uvigerina juncea* may represent the youngest part of the middle Purisima Formation (*Uvigerina juncea* zone; Goodwin and Thompson, 1954). Also included in sample Mf10318 are several species, which are probably reworked from the Miocene, probably Monterey Formation such as *Valvulineria californica* and several of the *Bolivina*.

Ecology:

Most of the foraminiferal assemblages in DMW1 indicate deposition occurred at inner neritic depths 0–50 meter based on the presence of *Elphidiella hannai* and *Elphidium hughesi*. In addition, the presence of several species of *Nonionella*, *Uvigerina juncea*, *Bolivina interjuncta*, *B. foraminata*, and *Bolivina vaughani* suggests that water depths were probably at the deeper end of this range.

Correlation:

Although the wells previously examined; MacDonald No. 1 (Ingle, 1985), and Marina Wells No. 10 (Ingle, 1985), 11 (Ingle, 1986), and 12 (Ingle, 1989) contain some of the same species and a reworked Miocene, the foraminiferal assemblages in these wells do not contain the key species *Nonionella cushmani* and *Elphidium hughesi* which distinguish the assemblages in the current well and suggest a Pliocene age. The faunas in the previously examined wells appear to be younger—that is, Pleistocene in age.

Micropaleontology. Lab No. ¹	Mf10318	Mf10322	Mf10321	Mf10323	Mf10324	Mf10325
Depth (feet)	1,151.99– 1,152.38	1,225– 1,230	1,305.84– 1,306.24	1,365– 1,370	1,410– 1,420	1,640– 1,660
<i>Bolivina advena striatella</i> (Cushman) ²	2					
<i>Bolivina</i> cf. <i>B. decussata</i> (Brady)	3					
<i>Bolivina californica</i> (Cushman) ²	1					
<i>Bolivina foraminata</i> (Stewart and Stewart)	1					
<i>Bolivina interjuncta</i> (Galloway and Wissler)	1					
<i>Bolivina marginata</i> (Cushman)	1					
<i>Bolivina vaughani</i> (Natland)	1					
<i>Buccella frigida</i> (Cushman)	20	3		2		
<i>Elphidiella hannai</i> (Cushman and Grant)	336	16	34	39	3	
<i>Elphidium hughesi</i> (Cushman and Grant)	241	47		48	4	6
<i>Nonionella cushmani</i> (Stewart and Stewart)	5	20		8	3	
<i>Nonionella miocenica</i> (Cushman)	21	8		8		
<i>Uvigerina juncea</i> (Cushman and Todd)	2					
<i>Valvulineria</i> cf. <i>V. californica</i> (Cushman) – juveniles ²	9	1				
Total foraminifers	644	95	34	105	10	6

¹No micro-fossils were observed in samples Mf10319 and Mf10320.

²Probably reworked fossils.

Mega-Fossil Analysis

U.S. Department of the Interior U.S. Geological Survey Report on Referred Fossils

Stratigraphic Range: Pliocene to possibly Pleistocene	Shipment No.:
General Locality: California	Number of Samples: 3
Quadrangle: Marina 7.5'	Region: Monterey Co.
Fossil Type: Mollusks	Referred by: R. T. Hanson
Formation: Purisima	Report by: C. Powell, II
Latitude: 36°41'57" N Longitude: 121°48'27"	Report date: 12/1/2000

This E&R report fossils mollusks from the Marina Well (DMW1), located in Marina State Park, Marina, Monterey County, California.

Field No.: DMW1 core 7 @ 23–58 cm.

Mollusca

Bivalvia

Clinocardium sp.

Macoma sp.

Gastropoda

Cryptonatica affinis (Gmelin)

Comments: These taxa are found from southern California to Alaska in water depths from the intertidal zone to at least 150 m. They are all living taxa which have fossil records back to the Miocene. They are not age or environmentally significant.

Field No.: DMW1 core 13 @ 127–131 cm.

Mollusca

Bivalvia

Macoma sp.

Comments: This genus is found from southern Chile to northern Alaska in water depths from the intertidal zone to over 1,500 m. It also has a fossil record back to at least the Oligocene. It is not age or environmentally significant.

Field No.: DMW1 core 14 @ 124–134 cm.

Mollusca

Bivalvia

Anadara trilineata (Conrad)

Comments: *Anadara trilineata* (Conrad) is well known from the Miocene to Pliocene from British Columbia south to southern California (Moore, 1983). It has also been reported from the Pleistocene Scotia Bluffs Sandstone (Roth, 1979), but I doubt this age call. This taxon suggest normal marine conditions at shelfal water depths and a late Miocene to late Pliocene age. It is common in the Purisima Formation.

APPENDIX 3: WATER-CHEMISTRY DATA FOR THE DMW1 MONITORING WELLS AND CORE PORE WATERS

The water-chemistry data obtained from sampling and analysis of the monitoring-well samples are reported in table A3.1, and the data collected from pore waters extracted from the wire-line cores retrieved during drilling are presented in table A3.2. Additional water-chemistry data from the nearby water-supply wells for 1995, 1997, and 2000 (C. Moss, Monterey County Water Resources Agency, written commun., 2000) were used for the purposes of comparison with the monitoring-well data. The boron and strontium isotope samples were collected along with the other water-chemistry samples for the DMW1 monitoring wells and analyzed by research geochemists Tom Bullen and John Fitzpatrick of the USGS, Water Resources Division. The additional water-chemistry data from other wells were sampled from joint sampling and analyses of upper-aquifer system wells in the Salinas Valley performed by the USGS and the University of California at Santa Cruz (Vengosh and others, 2002). The average composition of seawater (Hem, 1985) was used for hydrologic and water-chemistry comparisons.

Monitoring-Well Water

The water-chemistry samples from the DMW1 monitoring-site wells were collected under the USGS protocol established for water-chemistry sampling (Wilde and others, 1998). Water-chemistry samples were obtained from the deep-aquifer system monitoring wells with positive-displacement pumps after well development. The water-chemistry data are summarized by groups of constituents that are used for geochemical and hydrologic interpretations. These groups include major anions; dissolved-solids concentration and specific conductance; iron and manganese; other selected trace elements; pH, temperature, and dissolved oxygen; total dissolved carbon; tritium; stable isotopes of deuterium, oxygen, boron, and strontium; and the carbon (C^{14} and C^{13}) isotopes.

Major, Minor, and Trace-Element Chemistry— The major, minor and trace element chemistry are used to assess the chemical characteristics of the ground-water samples and help to determine the source and movement of the ground water.

Major anions – Chloride concentrations from monitoring-well samples ranged from 48 to 10,801 mg/L. The most saline samples from the nearby MCWD deep-aquifer system water-supply wells, greater than 100 mg/L of chloride, are from well No. 12 (Geoconsultants, Inc., 1989). Sulfate concentrations from monitoring-well samples ranged from 32 to 1,506 mg/L. Sulfate concentrations in all other samples from monitoring-well site (table A3.1) and MCWD deep-aquifer system water-supply wells (Geoconsultants, Inc., 1983, 1986, 1989) were less than 75 mg/L.

Dissolved-Solids Concentration and Specific Conductance – Dissolved-solids concentrations from monitoring-well samples ranged from 318 to 23,840 mg/L. The specific conductance ranged from 459 μ S/cm to 28,900 μ S/cm. The highest dissolved-solids and specific conductance values were from the ground-water sample from well DMW1-3. The lowest dissolved-solids concentrations and specific-conductance values were in water from DMW1-2.

Iron and Manganese – Iron and manganese concentrations from monitoring-well samples ranged from less than 10 to 150 μ g/L and 7 to 385 μ g/L, respectively.

Other Selected Trace Elements – Ground-water samples from deep-aquifer system monitoring-well site DMW1 contained iodide concentrations ranging from 0.07 mg/L in the deepest monitoring well (DMW1-1) to 0.19 mg/L in the shallowest monitoring well (DMW1-4). Barium concentrations ranged from 23 μ g/L in well DMW1-2 to 244 μ g/L in well DMW1-3. Strontium concentrations ranged from 76 μ g/L in well DMW1-2 to 19,827 μ g/L in well DMW1-3. Bromide concentrations ranged from less than 0.14 mg/L in well DMW1-2 to 39 mg/L in well DMW1-3. The water samples from the three deeper monitoring wells (DMW1-1, 2, 3) contained arsenic concentrations ranging from 6.4 to 7.3 μ g/L.

pH, Temperature, and Dissolved Oxygen— The pH values from deep-aquifer system monitoring-well samples are generally basic values, ranging from 7.1 to 8.5 for DMW1 water samples (table A3.1) and from 8.0 to 8.5 for water-supply well samples (Geoconsultants, Inc., 1983, 1986, 1989). The temperature of the water samples from the monitoring wells ranged from 21° to 26° Celsius (C). Temperatures as great as 36° C at 1,750 ft bls were measured with a wireline temperature probe during geophysical logging in the deep-aquifer system monitoring-well site and also were measured in several of the nearby MCWD deep-aquifer system water-supply wells (Geoconsultants, Inc., 1993). The dissolved-oxygen concentration measured in ground-water samples from the four deep-aquifer system monitoring wells ranged from 0.0 to 0.4 mg/L (table A3.1).

Total Dissolved Carbon – The concentration of total dissolved organic carbon for the DMW1 wells ranged from less than 0.33 to 0.88 mg/L carbon and was greatest in the sample from the shallowest well (DMW1-4) (table A3.1).

Stable Isotopes – Stable isotopes of oxygen and hydrogen (deuterium) are used to help determine the source of water, isotopes of boron help to identify the source of dissolved ions that contribute to poor-quality water, and isotopes of strontium help to infer the source of the sediments that the water flows through.

Oxygen-18 and deuterium are naturally occurring stable isotopes of oxygen and hydrogen. Oxygen-18 (^{18}O) and deuterium (D) abundances are expressed as ratios in delta notation as per mil (parts per thousand) differences relative to the standard known as Vienna Standard Mean Ocean Water (VSMOW) (Gonfiantini, 1978). Because the source of most of the world's precipitation is the evaporation of seawater, the delta- ^{18}O and delta-D composition of precipitation throughout the world is linearly correlated. This relation is known as the meteoric water line (Craig, 1961). The delta- ^{18}O and delta-D composition of ground water relative to the meteoric water line and relative to the isotopic composition of water from other sources is an indicator of the source and movement of ground water. The delta- ^{18}O and delta-D composition of water from monitoring wells ranged from -7.8 to -4.76 per mil and -32.5 to 54.6 per mil, respectively (table A3.1).

Boron-10 and -11 are naturally occurring stable isotopes of boron. Natural and anthropogenic processes fractionate the boron-11 content relative to boron-10. The abundance of boron-11 (^{11}B) is expressed in delta notation (del) as per mil (parts per thousand) differences relative to the standard reference boron isotopic ratio of boron-11 to boron-10 of 4.161 for National Bureau of Standards boric acid sample No. 951 (Tom Bullen, U.S. Geological Survey, written commun., 2001). Ground-water samples from the deep-aquifer system monitoring wells ranged in delta-boron-11 content from 7.7 to 26.7 per mil (table A3.1, fig. 13B).

Strontium-87/86 isotopes are naturally occurring stable isotopes of strontium and are expressed as a ratio (Faure and Powell, 1972). Strontium from ground-water samples undergoes cation exchange between calcium and strontium from the surrounding sediments. This exchange process is relatively rapid for most ground-water flow rates and results in a strontium isotopic composition of ground water that reflects the isotopic composition of the aquifer sediments. Therefore, strontium isotopes are a useful indicator of the source of the sediments that compose the aquifer. Strontium isotopes also can be affected by base-ion exchange during seawater intrusion, but this effect may be too localized to be discernable from sampling of ground water on a regional scale. The strontium isotopes of ground-water samples from deep-aquifer system monitoring wells ranged in strontium-87/86 ratio content from 0.70732 to 0.70841 (table A3.1, fig. 13A).

Unstable Isotopes—Unstable isotopes of water and carbon are used to identify the potential age of ground-water samples.

Tritium—Tritium (H^3) is a naturally occurring radioactive isotope of hydrogen having a half-life of 12.4 years. The activity of tritium is measured in pico curies per liter (pCi/L); and 1 pCi/L is equivalent to about 2.2 disintegrations of tritium per minute or about one tritium atom in 3.1×10^{17} atoms of hydrogen. Prior to 1952, the tritium concentration of precipitation in coastal California was about 6.5 pCi/L (Izbicki, 1996). Beginning in 1952, about 800 kilograms (1,760 pounds) of tritium was released as a result of the atmospheric testing of nuclear weapons (Michel, 1976), and the tritium activity of precipitation at Santa Maria, California, increased to more than 2,200 pCi/L (International Atomic Energy Agency, 1981). This release stopped in 1962 with the signing of treaties banning the atmospheric testing of nuclear weapons. Since that time, tritium activity in precipitation has decreased to pre-1952 levels. Because tritium can be part of the water molecule and tritium activities are not significantly affected by reactions other than radioactive decay, it is an excellent tracer of the movement of water

and relative age of water on time scales ranging from 0 to 50 years before present (Izbicki and others, 1993). No tritium was detected in samples from the deep-aquifer system monitoring wells (table A3.1). No tritium data are available from the deep-aquifer system water-supply wells.

Carbon Isotopes—Carbon-14 (^{14}C) is a naturally occurring radioactive isotope of carbon that has a half-life of about 5,730 years. Carbon-14 data are expressed as percentage modern carbon (pmc) by comparing carbon-14 activities with the specific activity of National Bureau of Standards oxalic acid: 12.88 disintegrations per minute per gram of carbon in the year 1950 equals 100 percent modern carbon. In addition to the naturally occurring carbon-14, carbon-14 also was produced during the atmospheric testing of nuclear weapons. As a result, carbon-14 activities can exceed 100 percent modern carbon. Carbon-14 is a tracer of the movement and relative age of water on time scales ranging from several hundred to more than 30,000 years before present. Because carbon-14 is not part of the water molecule, carbon-14 activities are affected by chemical reactions between dissolved constituents and aquifer material. As a result, carbon-14 data must be corrected using chemical, mineralogical, and carbon-13 data to evaluate chemical reactions that occur within an aquifer and to estimate the actual age of a water sample. Davis and Bentley (1982) estimated that errors in carbon-14 ages may be as much as 100 percent. The carbon-14 ages were adjusted in this study on the basis of the percentage of carbon-14 for initial waters. The carbon-14 content of ground-water samples of shallow aquifers from the Pajaro Valley were used from well (11S/3E-24D3M) with a carbon-14 content of 88 percent and tritium present. These samples represent a relatively recently recharged ground water. The percent of modern carbon-14 is increased by the resulting ratio of carbon-14 values to the 88 percent for the initial water of recent aquifer recharge. The values for uncorrected percent modern carbon were measured to be 4.0 pmc in DMW1-1 and 6.5 pmc in DMW1-2 (table A3.1).

Carbon-13 is a stable isotope of carbon. Carbon-13 data are expressed as ratios in delta notation as per mil differences relative to the ratio of carbon-13 to the more common isotope carbon-12 in standard Pee Dee Belemnite (PDB) (Gonfiantini, 1978). The delta-carbon-13 values for the deep-aquifer system monitoring wells at DMW1 ranged from -10.99 per mil to -11.11 per mil (table A3.1). Along with the presence of hydrogen sulfide noted during sampling of the DMW1 monitoring wells, this may indicate that the deeper wells are in a zone where reducing conditions and methanogenesis is occurring.

Pore Water

Pore-water samples were collected from most cores. Multiple samples at 6-inch intervals were taken from similar sediments within each core. These subsamples were combined and squeezed under pressure to extract the pore fluids. Chemical results from pore fluids can be compromised by drilling fluids when the sediments are relatively coarse grained. Because most of the samples from DMW1 cores are clay to fine sand, this is probably not an issue. The results of anion and selected isotope analyses for the pore-water samples are given in table A3.2.

Pore-water samples contained from 90 to 2,000 mg/L sulfate and 64 to 9,800 mg/L chloride (table A3.2). The pH values from all pore-water samples are generally basic, with values ranging from 7.8 to 9.8 (table A3.2). The Eh values from the pore waters ranged from 10 to 232 millivolts and generally represent reduced conditions.

Selected pore-water samples were also analyzed for deuterium and oxygen isotopes (table A3.2). The delta-oxygen-18 and the delta-deuterium values ranged from -4.62 to -6.94 per mil and from -33.08 to -54.0 per mil, respectively. These data generally plot below the meteoric water line (fig. 12). The squeezing process may cause mechanical fractionation of the oxygen isotopes. The offset of oxygen isotope values from the pore fluid samples from the DMW1 cores compared with the well samples may be the result of this fractionation process (fig. 13).

Table A3.1. Summary of water-chemistry data for the deep-aquifer monitoring-well site DMW1, Marina, California

Attribute	Units	State well number			
		14S/1E-24L5	14S/1E-24L4	14S/1E-24L3	14S/1E-24L2
Local well name		DMW1-4	DMW1-3	DMW1-2	DMW1-1
Station number		364157121482704	364157121482703	364157121482702	364157121482701
Sample type	Collection method	Pumped	Pumped	Pumped	Pumped
Depth of well	Feet	970	1,080	1,430	1,880
Depth of screened interval	Feet	930–950	1,040–1,060	1,410–1,430	1,820–1,860
Sample	Date	6/23/2000	6/24/2000	6/23/2000	6/25/2000
Sample	Time	1930	1730	2245	1945
Specific conductance, field	µS/cm @ 25C	661	28,900	456	868
Specific conductance, lab	µS/cm	672	28,500	459	881
pH, field	Standard	7.82	7.07	8.46	8.31
pH, lab	Standard	7.87	6.86	7.78	7.92
Temperature, water	Degrees C	21	22.5	21.5	26
Temperature, air	Degrees C	14	16.5	14	16.5
Oxygen, dissolved	mg/L	.2	.2	.4	0
Calcium, dissolved	mg/L	31.8	2,570	7.71	15.3
Magnesium, dissolved	mg/L	11.1	1,080	2.74	1.90
Sodium, dissolved	mg/L	94.0	2,770	81.1	164
Potassium, dissolved	mg/L	3.0	31.9	5.2	3.8
Alkalinity	mg/L	160	47	110	120
Alkalinity	mg/L as CaCO ₃	156	57	114	115
Sulfate, dissolved	mg/L	61.5	1,510	32.0	74.0
Chloride, dissolved	mg/L	68.6	10,800	47.8	153
Fluoride, dissolved	mg/L	.2	.2	.1	.2
Bromide, dissolved	mg/L	.17	39.1	.14	.56
Iodide, dissolved	mg/L	.186	.159	.019	.065
Silica, dissolved	mg/L	45.8	29.4	64.4	23.9
Solids, residue at 180°C	mg/L	417	23,800	318	506
Nitrogen, nitrite, dissolved	mg/L as N	<.010	<.010	<.010	<.010
Nitrogen, NO ₂ + NO ₃ , dissolved	mg/L as N	<.050	<.050	<.050	<.050
Nitrogen, ammonia, dissolved	mg/L as N	<.020	.722	.471	.557
Nitrogen, ammonia + organic, dissolved	mg/L as N	<.10	<.10	.50	.57
Phosphorous, dissolved	mg/L as P	.199	.063	.115	<.050
Phosphate, ortho, dissolved	mg/L as P	.184	.069	.113	.014
Aluminum	µg/L	<15	<225	E10	E9
Barium, dissolved	µg/L	57	244	23	47
Boron, dissolved	µg/L	145	252	94	108
Iron, dissolved	µg/L	<10	<150	<10	<10
Arsenic	µg/L	6.8	7.3	6.4	<2.0
Lithium	µg/L	40.8	406	32.9	35.0
Manganese, dissolved	µg/L	20.512	384.77	7.1839	11.876
Strontium, dissolved	µg/L	353	19,800	76.3	387
Delta-deuterium	Per mil	-54.6	-32.5	-48	-51.6
Delta oxygen-18	Per mil	-7.8	-4.76	-7.12	-7.36
Tritium	pCi/L	.4	<0.3	<0.3	<0.3
Tritium, prec. est.	pCi/L	.58	.64	.64	.64
Carbon-13/12	Per mil	-10.99	-11.11	-13.32	-11.11
Carbon-14	Percent modern carbon	2.110	2.840	6.530	4.040
Strontium-87/86	Ratio	.70841	.70732	.70855	.70805
Delta-boron-11	Per mil	11.00	7.70	26.70	21.70

Table 3.2. Summary of water chemistry for pore-water extractions from cores for the deep-aquifer monitoring-well site, Marina, California.

[—, no data]

Drill site core number	Sample depth, feet below land surface	Percent Salt grams (NaCl per 100 grams water)	Percent seawater (as chloride)	pH, lab (standard units)	Reduction- oxidation potential (millivolts as Eh)	N-NO ₂ (mg/L as N)	N-NO ₃ (mg/L as N)	Chloride, dissolved (mg/L)	Bromide, dissolved (mg/L)	Phospho- rus, ortho (mg/L as P)	Sulfate, dissolved (mg/L as SO ₄)	O ¹⁸ /O ¹⁶ (ratio per mil)	H ² /H ¹ (ratio per mil)
CDMW1- 1	822–827	0.08	2	—	—	0.10	<0.04	305	<1.2	<1.2	200	–6.94	–54.0
CDMW1- 2a	922–927	.05	1	—	—	<.08	.77	127	<1.2	<1.2	200	–6.7	–52.27
CDMW1- 2b	922–927	.10	2	—	—	.09	—	300	<1.2	<1.2	505	—	—
CDMW1- 3	927–932	.05	1	7.8	160	<.04	.22	115	<.6	<.6	185	—	—
CDMW1- 4	932–937	.05	1	8.2	200	<.04	2.6	114	<.6	<.6	185	—	—
CDMW1- 5	937–942	.05	1	8.1	232	<.04	2.1	123	<.6	<.6	190	–6.92	–52.61
CDMW1- 6	1,042–1,047	.27	7	—	—	<.2	<.2	1,300	3.2	<3	700	–5.25	–38.6
CDMW1- 7	1,102–1,107	1.55	52	8.5	—	<2	<2	9,800	<30	<30	1,500	–4.62	–33.08
CDMW1- 7	1,102–1,107	1.55	52	—	—	<20	<20	9,800	<300	<300	2,000	—	—
CDMW1- 8	1,212–1,217	.07	1	8.9	62	.03	.19	170	<.3	<.3	285	–6.49	–43.78
CDMW1- 8	1,212–1,217	.07	1	—	—	<.04	.16	170	.6	<.6	280	—	—
CDMW1- 8	1,212–1,217	.07	1	—	—	.02	.27	175	.3	<.3	290	—	—
CDMW1- 8	1,212–1,217	.07	1	—	—	.02	.22	185	.4	<.3	310	—	—
CDMW1- 10b	1,262–1,267	.05	<1	9.7	—	<.04	.60	81	<.6	<.6	145	—	—
CDMW1- 11	1,267–1,272	.06	<1	9.8	10	.06	.04	98	<.6	<.6	205	—	—
CDMW1- 12	1,272–1,277	.06	1	—	—	.13	.82	122	<1.2	<1.2	200	–6.2	–44.51
CDMW1- 13	1,312–1,317	.05	1	9	70	<.04	.58	67	<.6	<.6	150	—	—
CDMW1- 14	1,317–1,322	.05	1	9.3	62	<.04	.35	64	<.6	<.6	130	–6.64	–46.15
CDMW1- 15	1,717–1,722	.07	1	8.5	115	.16	.66	146	.9	<.6	195	—	—
CDMW1- 16	1,722–1,727	.08	1	8.5	140	<.04	<.04	142	<.6	<.6	210	—	—
CDMW1- 18	1,732–1,737	—	—	—	180	—	—	—	—	—	—	—	—
CDMW1- 19	1,972–1,977	.21	6	8.1	110	<.04	.44	1,100	2.9	<.6	90	–6.56	–47.5